

CLAIMS

What is claimed is:

1. A pump assembly for circulating a supercritical fluid, comprising: an impeller for pumping fluid between a pump inlet and a pump outlet; a rotating pump shaft coupled to the impeller, wherein the pump shaft is supported by corrosion resistant bearings; a rotor of a DC motor potted in epoxy and encased in a non-magnetic material sleeve; and a stator sealed from the fluid via a polymer sleeve.
2. The pump assembly of claim 1, wherein the bearings are non-lubricated.
3. The pump assembly of claim 1, further including an electrical controller suitable for operating the pump assembly, wherein the electrical controller comprises a commutation controller for sequentially energizing windings of the stator.
4. The pump assembly of claim 1, wherein the pump is of centrifugal type.
5. The pump assembly of claim 1, wherein the bearings are made of silicon nitride balls with bearing races made of Cronidur®.
6. The pump assembly of claim 1, wherein the bearings are one of following: ceramic bearings, hybrid bearings, full complement bearings, foil journal bearings, or magnetic bearings.
7. The pump assembly of claim 1, wherein the polymer sleeve is a PEEK™ sleeve.
8. The pump assembly of claim 1, wherein the non-magnetic material is stainless steel.

- 1     9.     The pump assembly of claim 1, wherein the impeller has a diameter between 1 inch and 2  
2           inches.
- 1     10.    The pump assembly of claim 1, wherein the rotor has a diameter between 1.5 inches and  
2           2 inches.
- 1     11.    The pump assembly of claim 1, wherein the rotor has a maximum speed of 60,000 rpm.
- 1     12.    The pump assembly of claim 1, wherein an operating pressure of the pump assembly is in  
2           the range 1,500-3,000 psi.
- 1     13.    The pump assembly of claim 1, wherein the supercritical fluid operates in the range 40-  
2           100 degrees Celsius.
- 1     14.    The pump assembly of claim 1, wherein the supercritical fluid is supercritical carbon  
2           dioxide.
- 1     15.    The pump assembly of claim 1, wherein the supercritical fluid is supercritical carbon  
2           dioxide admixed with an additive or solvent.
- 1     16.    The pump assembly of claim 1, wherein a portion of the supercritical fluid passes through  
2           the pump assembly and then back to the pump inlet through an outer flow path, the outer  
3           flow path including a filter to clean particles generated by a motor assembly.
- 1     17.    The pump assembly of claim 1, wherein the motor is a variable speed motor.

- 1     18.     The pump assembly of claim 1, wherein the motor is an induction motor.
- 1     19.     The pump assembly of claim 1, wherein the non-magnetic material sleeve is welded to  
2           the pump shaft such that torque is transferred through the non-magnetic material sleeve.
- 1     20.     A pump assembly for circulating a supercritical fluid, comprising: an impeller for  
2           pumping fluid between a pump inlet and a pump outlet; a rotating pump shaft coupled to  
3           the impeller, wherein the pump shaft is supported by non-lubricated bearings; a rotor of a  
4           DC motor potted in epoxy and encased in a stainless steel sleeve, the stainless steel sleeve  
5           being welded to the pump shaft such that torque is transferred through the stainless steel  
6           sleeve; and a stator sealed from the fluid via a PEEK<sup>TM</sup> sleeve, the rotor and the stator  
7           defining an alternative flow path to divert a portion of the supercritical fluid through the  
8           pump assembly and then back to the pump inlet through an outer flow path.
- 1     21.     The pump assembly of claim 20, further including an electrical controller suitable for  
2           operating the pump assembly, wherein the electrical controller comprises a commutation  
3           controller for sequentially energizing windings of the stator.
- 1     22.     The pump assembly of claim 20, wherein the pump is of centrifugal type.
- 1     23.     The pump assembly of claim 20, wherein the impeller has a diameter between 1 inch and  
2           2 inches.
- 1     24.     The pump assembly of claim 20, wherein the rotor has a diameter between 1.5 inches and  
2           2 inches.
- 1     25.     The pump assembly of claim 20, wherein the rotor has a maximum speed of 60,000 rpm.

- 1     26.     The pump assembly of claim 20, wherein an operating pressure of the pump assembly is  
2             in the range 1,500-3,000 psi.
- 1     27.     The pump assembly of claim 20, wherein the supercritical fluid operates in the range 40-  
2             100 degrees Celsius.
- 1     28.     The pump assembly of claim 20, wherein the supercritical fluid is supercritical carbon  
2             dioxide.
- 1     29.     The pump assembly of claim 20, wherein the supercritical fluid is supercritical carbon  
2             dioxide admixed with an additive or solvent.
- 1     30.     The pump assembly of claim 20, wherein the bearings can be made of silicon nitride balls  
2             combined with bearing races made of Cronidur®.
- 1     31.     The pump assembly of claim 20, wherein the bearings are one of following: ceramic  
2             bearings, hybrid bearings, full complement bearings, foil journal bearings or magnetic  
3             bearings.
- 1     32.     The pump assembly of claim 20, wherein the motor is a variable speed motor.
- 1     33.     The pump assembly of claim 20, wherein the motor is an induction motor.